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Michael L. Avery
U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Science and Technology, Denver Wildlife Research Center, Florida Field Station, michael.l.avery@aphis.usda.gov

John W. Nelson
Tower View Nursery, South Haven, MI

Marcia A. Cone
Office of Sponsored Research, University of Florida, Gainesville

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MICHAEL L. AVERY, U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Science and Technology, Denver Wildlife Research Center, Florida Field Station, 2820 E. University Avenue, Gainesville, FL 32601
JOHN W. NELSON, Tower View Nursery, South Haven, MI 49090
MARCIA A. CONE, Office of Sponsored Research, University of Florida, Gainesville, FL 32611

Abstract: In this survey of 15 states and British Columbia, 84% of the 49 respondents considered bird damage to blueberries (*Vaccinium* sp.) to be serious or moderately serious. As in a similar 1972 survey, the European starling (*Sturnus vulgaris*), American robin (*Turdus migratorius*), and common grackle (*Quiscalus quiscula*) were listed as the most serious pest species. Most of the people surveyed who formerly used Mesurol[R] to control bird depredations felt that the severity of bird damage increased in 1989 when the registration for Mesurol[R] use on fruit lapsed. Based on the responses to this survey, we conservatively estimate that 10% of the blueberry crop was damaged by birds in 1989. If this damage estimate is applied to the total 1989 United States blueberry production (71.7 million kg), and assuming an average price of $1.10/kg, then bird damage may have cost growers $8.5 million nationwide.

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Blueberry production in the United States increased by approximately 75% between 1977 and 1987, and the area devoted to blueberry production today exceeds 40,000 ha (90,000 ac; Hancock and Draper 1989). Among the several factors that can negatively impact blueberry production is bird damage. Although the impact of birds on blueberries has been addressed locally (e.g., Conover 1982, Nelms et al. 1990, Strik 1990), an attempt to evaluate the extent of bird damage nationwide has not been made for almost 20 years (Mott and Stone 1973).

Recently, growers' options for controlling bird damage were reduced when a decision was made not to reregister the chemical repellent Mesurol[R] for use on blueberries and other small fruits. In response to concerns expressed by its membership over the loss of Mesurol[R], the North American Blueberry Council (NABC) conducted a survey to assess bird damage problems in North America. In this report, we describe findings of the survey and compare them to those of Mott and Stone (1973).

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METHODS

We attempted to obtain as broad a perspective as possible of the bird damage problem. Thus, instead of polling all individual producers for their specific problems, we sent questionnaires to 38 members and associate members of the NABC and to 10 members of the NABC Research Committee. In addition, we sent 22 questionnaires to blueberry researchers and extension personnel. The questionnaire used was modeled after that of Mott and Stone (1973) and included questions used in the earlier one, plus 2 others specific to the use of Mesurol[R] (Appendix A).

Our study design is not statistically valid. Thus, results of the survey must be interpreted cautiously. The results represent opinions and judgements of certain knowledgeable individuals, and were not derived from replicated studies, or from sources chosen in a statistically valid manner.

RESULTS

Extent of Damage and Species Reponsible

Forty-nine responses were received from 15 states and British Columbia, whereas Mott and Stone (1973) received 42 replies from 14 states (Table 1). The acreage represented in the survey increased considerably due primarily to the inclusion of Maine. Forty-one of the 49 (84%) respondents in this survey regarded bird damage as serious or moderately serious, compared with 37 of 42 (88%) in 1972.

As in 1972, European starlings, American robins, and common grackles were the 3 most common species causing damage to blueberries (Table 2). Increases in the incidence of blueberry damage occurred for several species: house finch (*Carpodacus mexicanus*), crow (*Corvus* spp.), cedar waxwing (*Bombycilla cedrorum*), and gull (*Larus* spp.). Other species seem to have decreased in importance: blue jay (*Cyanocitta cristata*), oriole (*Icterus* spp.), and brown thrasher (*Toxostoma rufum*). The status of the northern mockingbird (*Mimus polyglottos*) was unchanged. Only Mississippi and Texas failed to list robins, while starlings were absent only from Minnesota and Texas. Although cedar waxwings and gulls are not as widespread as other depredating species, they are important where they occur. Eight of 9 respondents from Maine and New Jersey listed gulls as the most important bird depredator. Respondents in Florida, Georgia, Texas, and Washington considered cedar waxwings to be a species of major concern.

Damage Control Methods

Respondents indicated that a variety of bird damage control methods were employed, but most considered the available

techniques to be ineffective (Table 3). Netting was the exception, as it was clearly the most effective technique. Several respondents commented, however, that netting was impractical and not cost-effective for large holdings. In the 1972 survey, 24 respondents in 11 states listed netting as a technique that was used, but in our survey, netting occurred on just 14 responses from 9 locales. Thirty-eight respondents listed more than one method used, and 5 considered a combination of methods to be the most effective approach to bird damage control. Five of the people surveyed did nothing to deter birds, either because they had no bird depredations, or because no effective method was available. Although Mesurol® is no longer registered for blueberries, 7 respondents considered it the most effective technique. Nonacoustic scare devices were listed 46 times, but only once was this approach considered to be most effective.

Table 1. Numbers of responses and blueberry acreage estimated from North American surveys during 1972 and 1989.

Locale	Responses 1972	Responses 1989	Estimated Blueberry Acreage 1972	Estimated Blueberry Acreage 1989
Arkansas	1	2	20	500
British Columbia	0	3	-	1,600-2,000
Florida	1	4	30	400-1,000
Georgia	2	3	200	480-1,600
Maine	0	5	-	20,000
Michigan	6	6	2,800-4,000	6,000-6,400
Minnesota	0	1	-	40
Mississippi	0	2	-	320-400
Missouri	0	1	-	50
New Jersey	6	5	2,800-4,000	3,200-3,400
New York	3	1	100-200	400-500
North Carolina	2	1	1,880	1,440
Ohio	0	1	-	100
Oregon	3	8	120	400-520
Texas	0	1	-	530
Washington	3	5	240-320	280-400
Total	42[a]	49	8,520-11,250[a]	35,750-39,000

[a] Includes 15 responses from 5 states (Indiana, Louisiana, Massachusetts, Rhode Island, and Vermont) not represented in present survey.

Acoustic scare techniques (excluding shooting) were listed 47 times and in 3 instances these were perceived as the best technique. Shooting, both for hazing and for killing the offending birds, was the single most frequently employed method, and 7 respondents deemed it the most effective technique.

Factors Affecting Bird Damage

Most respondents considered bird abundance to be an important factor influencing the occurrence of bird damage to blueberries (Table 4). Proximity of the planting to roosting/loafing sites and other vegetation attractive to the birds was the next most frequently listed factor, followed by the size of the planting, and the availability of alternate foods. Several respondents commented that small plantings were more prone to serious bird problems than were larger holdings.

In British Columbia, proximity to dairy operations that attract large numbers of starlings was mentioned as a factor contributing to bird damage. In Maine and New Jersey, where gulls are major problem species, damage was influenced by proximity to the coast and to landfills. Other persons commented that damage seemed to increase in dry years, when presumably, naturally occurring alternative foods were scarce. Overwhelmingly, the bird damage was to ripe or ripening fruit. Damage to buds or blossoms was insignificant.

Table 2. Bird species most commonly implicated in damage to blueberries, 1972 and 1989.

Species	Number of responses 1972	Number of responses 1989	Number of locations 1972	Number of locations 1989
European starling	34	38	11	14
American robin	31	31	10	13
Common grackle	22	17	8	13
House finch	7	17	3	7
Crows	2	13	2	8
Cedar waxwing	2	11	2	6
Gulls[a]	0	9	0	2
Northern mockingbird	6	5	4	4
Blue jay	9	3	4	3
Orioles	11	2	5	2
Brown thrasher	6	2	5	2

[a] Probably laughing gulls (*Larus atricilla*) in New Jersey; probably ring-billed gulls (*L. delawarensis*) in Maine.

Table 3. Frequency of use and perceived effectiveness of bird control methods for reducing damage to blueberries during 1989.

Method	No. of respondents using the method	No. considering it the most effective method
Shooting (for hazing and for killing depredators)	29	7
Electronic scare devices	25	2
Exploders	22	1
Reflectors	22	0
Scarecrows	15	0
Netting	14	14
Traps	11	2
Balloons	9	1
Mesurol®	0	7
Combination of methods	38	5

Table 4. Number of respondents that listed various factors as important influences on blueberry damage by birds during 1989.

Locale	Bird abundance	Proximity of attractive vegetation	Size of planting	Alternate food	Distance to other orchards	Proximity to
Arkansas	2	1	1	1	1	
British Columbia	3	2		2		Dairies
Florida	4	2	2	1	1	
Georgia	1		2			
Maine	2		1	2		Coast
Michigan	6	3	1	1		
Minnesota		1	1		1	
Mississippi	2	1	2	2		
Missouri	1	1		1		
New Jersey	2			1		Landfills
New York	1	1	1	1	1	
North Carolina	1		1			
Ohio	1	1				
Oregon	8	5	3	3	1	Water
Texas	1		1			
Washington	5	4	5	1	1	

Importance of Mesurol[R]

Eighteen respondents felt that they experienced more than usual bird damage in 1989, 17 felt that bird damage was about the same, and 11 had less bird damage than normal. In 1989, growers were unable to use Mesurol[R] to control bird damage, and 10 of 18 respondents who experienced increased bird damage attributed the increase to the unavailability of Mesurol[R].

Eleven respondents cited 1989 as the year of greatest bird damage, and 8 of these individuals used Mesurol[R] prior to 1989. Respondents in New Jersey and Minnesota also felt 1989 was their worst year, but they had never used Mesurol[R]. Altogether, 18 replies indicated that their greatest losses occurred when Mesurol[R] was not used, 5 said that Mesurol[R] was not a factor in their losses, and 11 had never used it.

Relative Impact of Bird Damage

Most respondents considered bird damage to be more important than several other factors that also affect production (Table 5). Only frost damage approached bird damage in overall importance according to our survey. The pattern of responses to this question was similar to that obtained by Mott and Stone (1973), except that they recorded many more 'Do not know' responses than we did (Table 5).

Diseases are major problems in many regions (Hancock and Draper 1989), but were not included in this survey question. It is surprising that in their review of the North American blueberry industry, Hancock and Draper (1989) did not mention bird damage. It is apparent from our survey (Table 5) that most respondents perceive birds to be at least equal in severity to insect pests and various weather-related constraints in production.

Few respondents were willing to hazard quantitative estimates as to the extent of bird damage in their area, or the amount of money spent to control bird damage (Table 6). Nevertheless, only Georgia, Minnesota, Mississippi, New York, and Texas did not indicate that bird damage was a serious problem. Together, these states comprise a relatively small portion (1,760-3,040 ha) of the nationwide blueberry industry (Table 1). The 5 largest producing areas (Maine, Michigan, New Jersey, British Columbia, and North Carolina), reported serious bird problems, at least locally (Table 6).

DISCUSSION

Bird Control Measures

Blueberry production has increased rapidly in recent years and is likely to continue to increase (Hancock and Draper 1989). As acreage grows and production expands to new areas, bird damage problems are also certain to increase (Nelms et al. 1990).

Respondents to our survey expressed dissatisfaction with each of the available bird damage control techniques except netting (Table 3). Although netting was effective, it is an expensive method to employ (Conover 1982), and many owners of small plantings do not invest in this technique. Unfortunately, it is these small holdings that seem to incur disproportionately serious bird losses. Apparently, bird-proof nets were once more widely used than they are now. Mott and Stone (1973) received 24 replies that indicated that netting was used to control bird damage, whereas only 14 of our respondents used netting.

Given the apparent effectiveness of netting, the decline in its frequency of use indicated by our survey is somewhat puzzling. Possibly, the development and availability of Mesurol[R]

subsequent to the initial survey resulted in growers abandoning nets in favor of the chemical repellent. Mesurol[R] has been unavailable since 1989, perhaps too short a time for many growers to switch back to netting.

Table 5. Severity of bird damage relative to other factors affecting blueberry production in the U.S. during 1989.

Other types of losses	Number of respondents reporting bird damage as: More serious	Similar	Less serious	Do not know
Insects	28	2	14	1
Hail	32	2	4	4
Frost	20	8	17	1
Wind	31	0	8	1
Rain	27	8	11	1
Totals	138	20	54	8
Totals from Mott and Stone (1973)	117	5	22	62

Populations of Problem Species

The emergence of gulls as pests to blueberries was not anticipated from Mott and Stone's (1973) results. This is partly because their survey included only highbush blueberries. In Maine, where gulls are a major problem, lowbush blueberries are produced. Although New Jersey was included in the earlier survey, none of those 6 respondents mentioned gulls. Conversely, 4 of 5 New Jersey respondents indicated gulls were responsible for most avian blueberry losses reported in this survey. The laughing gull (*Larus atricilla*), the species most often causing damage to blueberries (E. Butler, Anim. Damage Control, pers. commun.), virtually doubled its population in New Jersey during the period 1977-85 (Spendelow and Patton 1988, Dolbeer et al. 1989), and the number of colonies increased from 25 to 80 in the same period.

Expanding regional populations of other bird species may also help to explain their increasing importance as blueberry depredators. For example, fish crow (*Corvus ossifragus*) populations have increased substantially in the southeastern United States since the mid-1960s (Robbins et al. 1986), and 7 of the respondents from Florida, North Carolina, and Mississippi listed crows as a major problem. Similarly, eastern populations of the house finch have expanded dramatically (Robbins et al. 1986), and this is reflected in 5 reports of finch damage in 3 eastern states (New Jersey, New York, Michigan) compared with 1 (New York) in 1972.

Economics of Bird Damage

Some respondents to our survey felt that they may have suffered more bird damage in 1989, the first year Mesurol[R] was unavailable, than during preceding years. A more detailed survey of Oregon growers (Strik 1990) bears this out. Bird damage in 1989 averaged about 10% on Oregon blueberry farms, roughly twice the damage that occurred in 1988. Furthermore, in 1989 many growers lost money because of pecked berries that resulted in grade reductions. This was virtually nonexistent during 1988 (Strik 1990).

Table 6. Economic impact of bird damage to blueberries.

Locale	Extent of damage	Amount spent to control damage
Arkansas	20-30% of a $1.5 million crop	very little
British Columbia	10-20%	$250/ha; $18,000 on 1 farm
Florida	10-50%	$20,000/yr statewide
Georgia	no estimate	none
Maine	limited statewide; may be serious locally	none
Michigan	10-20%	$250/ha
Minnesota	no estimate	no estimate
Mississippi	minor	very little
Missouri	40% (1 field)	no estimate
New Jersey	considerable, but no figures	no estimate
New York	no estimate	no estimate
North Carolina	5-10% large fields, 60-70% small fields	not very much
Ohio	major concern, but no figures	no estimate
Oregon	3-33%, with average of 25%	no estimate
Texas	very low level	none
Washington	light damage in the south, extensive in the north	considerable

Based on our survey results (Table 6), a conservative estimate of bird damage to blueberries in 1989 is 10%. It is important to remember that this estimate is not derived from a statistically valid survey, but represents instead the best guesses of selected, knowledgeable persons familiar with the problem of birds in blueberries. The 10% damage estimate is consistent with more detailed survey results from Oregon (Strik 1990), and is twice the damage estimate used by Mott and Stone (1973).

Total blueberry production in the United States in 1989 was 71.7 million kg (158 million pounds; North Am. Blueberry Counc. 1990). If we assume that birds took 10% of the crop, then actual production may have been in excess of 79.5 million kg, and birds may have consumed nearly 8 million kg.

The price of blueberries varies widely, depending in part on the time of year and whether they are fresh or processed (North Am. Blueberry Counc. 1990). For example, early season fresh market berries from Florida may be priced at $22/kg ($10/lb) or more (Nelms et al. 1990), whereas an average price in Oregon may be $1.21/kg (55¢/lb; Strik 1990). Assuming a conservatively-low average price of $1.10/kg (50¢/lb), then the hypothetical bird consumption of 8 million kg of

blueberries in 1989 represents a potential economic loss of $8.8 million. This is more than 4 times the loss estimate of $2 million in 1972 (Mott and Stone 1973).

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Appendix A. Form sent to survey participants.

QUESTIONNAIRE ON BIRD DAMAGE TO BLUEBERRIES

Please check appropriate box and add comments.

1. Do you think bird damage to blueberries in your state is:

a. A serious problem? [ ]
b. A moderate problem? [ ]
c. A slight problem? [ ]
d. No problem? [ ]

Comments:

2. What bird species are involved in blueberry damage in your state? Indicate importance of each (e.g., 1st, 2nd, etc):

a. Starlings? [ ]
b. Robins? [ ]
c. Grackles? [ ]
d. House Finches? [ ]
e. Others? Please list:

Comments:

3. What method is currently employed to reduce bird damage to blueberries:

a. Shooting of offending birds? [ ]
b. Netting of blueberries? [ ]
c. Traps? [ ]
d. Poisons? [ ]
Which?
e. Nest Removal? [ ]
f. Exploders? [ ]
g. Electronic scare devices? [ ]
(e.g. Av-Alarm, Biosonics)
h. Reflectors? [ ]
i. Scarecrows? [ ]
j. Others? Which? [ ]

Comments:

4. Which of the above methods do you think is:

a. Most frequently used?
b. Most effective?

Comments:

5. What do you feel are factors influencing bird damage to blueberries?

a. Size of planting? [ ]
b. Proximity of planting to vegetation attractive to birds? [ ]
c. Distance to neighboring plantings? [ ]
d. An abundance of birds? [ ]
e. Alternative wild foods? [ ]
f. Others? Which?

Comments:

6. Is bird damage to blueberries this year more or less, or about the same as that usually experienced?

Comments:

7. What year did the greatest damage occur?

8. Was this before the use of MESUROL[R]?

9. Is bird damage to blueberries limited only to ripening fruit, or do the birds attack the buds also?

Comments:

10. How do you rate bird damage to blueberries with other type of losses?

	More	Similar	Less	Don't Know
Insects	[ ]	[ ]	[ ]	[ ]
Hail	[ ]	[ ]	[ ]	[ ]
Frost	[ ]	[ ]	[ ]	[ ]
Wind	[ ]	[ ]	[ ]	[ ]
Rain	[ ]	[ ]	[ ]	[ ]

Comments:

11. Do you have any *loss figures* on a *state, county,* or *field* basis for bird damage to blueberries? If so, please indicate percent or dollar loss, species of birds involved, and source of your information.

Comments:

12. Do you have an estimate of the amount of money spent on bird damage prevention for blueberries on a local or statewide basis?

Comments:

13. Do you have an estimate of the number of acres of blueberries grown in your state?

Comments:

Name_____

Affiliation_____